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Contralateral coordination of walking legs in the crayfish

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The legs of a walking animal have to be coupled in order to obtain stepping patterns with stable temporal relationships. A previous investigation of crayfish concentrated on the coordinating mechanisms which couple ipsilateral legs (Cruse and Müller, J.exp.Biol. 121, 349-369, 1986). Coupling between contralateral legs was found to be weaker than ipsilateral coupling but not described in detail. These contralateral effects are described here.

The crayfish walked on a treadmill arranged so that each side of the animal walked on a separate belt. When the two belts were driven at slightly different speeds, the animal nevertheless attempts to maintain the coordination of the legs on both sides.

Leg movement was recorded as an analog signal, which was stored on tape and then analyzed to calculate the so-called Phase Response Curves (PRC) using a peak detector and an Apple II microcomputer. The abscissa shows the phase during the period of the reference leg; the ordinate shows the return stroke duration in percent of the period of the reference leg. A contralateral pair of legs is analyzed using first one and then the other as the reference leg the results usually show an obvious difference (Fig 1,2 small dots). One leg clearly dominates the other. In general the dominant leg is that leg which walks more slowly. This dominance makes a quantitative investigation of the coupling influences feasible. The PRC shows that the return stroke can be modulated according to the phase, but the effect is small compared to ipsilateral coupling. For comparison, the mean values of the PRC for the posteriorly directed effect between ipsilateral legs is shown by large dots (+/- SD) in Fig 2.

The results indicate that the contralateral coupling influences act only between legs within a segment. Qualitatively the strength of coupling increases from front to back.